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ABSTRACT

The major goal of the Developmental and Demonstration Project in Adult Basic Education at North Carolina State University is to identify, develop, and evaluate innovative materials and instructional systems that will accelerate and enhance the learning process in undereducated adults through the use of modern educational technology and media. Emphasis has been placed on determining the appropriate role of computer assisted instruction, programed instruction, and other self-instructional media in teaching adults. The purposes of this paper are to generate discussion in regard to the research opportunities and possibilities within the Adult Learning Resources Center at North Carolina State University; to review examples of current related research; to suggest specific research problem areas; and to delineate desired methodological procedures. (Author/MF)

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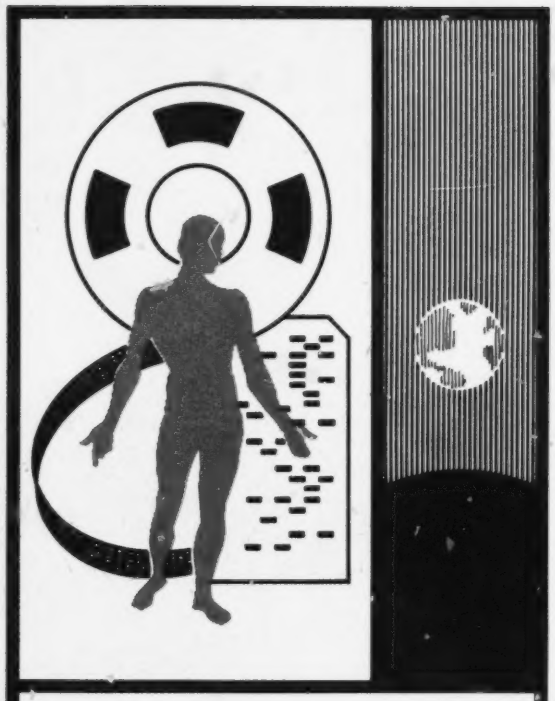

NCSU
ADULT
LEARNING
RESOURCES
PROJECT

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Research Reports

June, 1969, No. 1

THE USE OF MODERN EDUCATIONAL TECHNOLOGY FOR INSTRUCTION OF UNDEREDUCATED ADULTS: RESEARCH POSSIBILITIES

DEPARTMENT OF ADULT EDUCATION
NORTH CAROLINA STATE UNIVERSITY
RALEIGH, NORTH CAROLINA

A0006738

NCSU ADULT LEARNING RESOURCES PROJECT

This is a demonstration project funded by the Adult Education Branch of the U.S. Office of Education. It is an integral part of the research and development program of the Department of Adult Education at North Carolina State University.

PURPOSE

Purpose of the project is identification, development, demonstration and evaluation of innovative curriculum materials and instructional methods that will accelerate and enhance learning for undereducated adults. Special emphasis is placed on the use of educational media.

CURRICULUM

Currently available self-directed and programmed instructional materials in reading, computation, home and family life, consumer education and citizenship are being used. New instructional materials in these and other fields are being developed, adapted for programmed and computer assisted instruction and used in research designs which test their effectiveness with adult learners.

SPECIAL MEDIA

Educational media in use include an IBM 1500 Computer Assisted Instructional System. Computer assisted instruction (CAI) programs are designed for individualized instructional purposes and demonstrate the unique role of the computer in the teaching-learning situation.

Capabilities of CAI systems permit unlimited variation in teaching techniques. Drill and practice; tutor and test; games and simulation are only four of numerous CAI learning elements. An exciting new element is learner-controlled instruction, which allows the student to choose and pursue the path of learning he finds most challenging.

Additional teaching media expand the project's capacity to offer and evaluate individualized instructional strategies. These media include the electronic remote blackboard; the Language Master; programmed textbooks and video tape recorders.

STUDENTS

Students who come to the center are volunteer learners. Any adult, age 18 or over, who wishes to improve his basic educational and social skills, is eligible to enroll. Study schedules are conveniently arranged from 8 a.m. to 10 p.m. Each student is enrolled in a program designed to meet his personal needs and goals.

OUTREACH

Another dimension of the project is dissemination of information. "Outreach" efforts include communication of activities and results to other institutions, agencies and individuals involved in local, state, regional and national adult basic education programs.

Training is an important component. In-service seminars, institutes and workshops for adult basic education teachers, teacher-trainers and administrators are conducted for local, state and regional groups.

Additional training is provided through electronic sending and receiving units installed at four community colleges. One instructor at the center's master control system can teach as many as five groups simultaneously.

LOCATION

The project is located in an off-campus learning center at 733 West Hargett St., Raleigh, within easy access of students. Facilities are arranged to allow adult learners to study individually, both in a learning laboratory and at CAI terminals.

VISITORS

Educators, potential students and other interested persons are welcome at the North Carolina State University Adult Learning Resources Project. Visits may be arranged by calling the Adult Learning Center at Raleigh telephone number 755-2810.

Written inquiries should be addressed to the Project Director at 733 West Hargett St., Raleigh, N. C., zip 27603.

This publication is an extension of Project OEG-2-7-00390303903 of the Adult Branch, U.S. Office of Education. Prepared and distributed in furtherance of Section 309, Adult Education Act of 1966. Cooperating with Department of Adult Education, North Carolina State University, Raleigh, N. C.

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Research Reports
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THE USE OF MODERN EDUCATIONAL TECHNOLOGY FOR INSTRUCTION OF UNDEREDUCATED ADULTS: RESEARCH POSSIBILITIES

Ronald H. Sherron
Research Coordinator

P R E F A C E

One of the major objectives of the Adult Learning Resources Project is to communicate the findings and results of the Project's research efforts to concerned adult educators. This objective is being accomplished by conducting special workshops and training groups, holding orientation sessions, producing slides, films, tapes, and a variety of publications. One type of publication will be a series of research reports.

This initial report identifies and discusses the relevant research possibilities within the Adult Learning Resources Project. Subsequent reports will present the results of the Project's research efforts as it seeks to identify, develop, demonstrate, and evaluate innovative instructional systems that will accelerate the learning process for the millions of undereducated adults.

--J. B. Adair
Project Director

June, 1969

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THE USE OF MODERN EDUCATIONAL TECHNOLOGY FOR INSTRUCTION OF UNDEREDUCATED ADULTS: RESEARCH POSSIBILITIES

Introduction

The purposes of this paper are to:

--Generate a discussion in regard to the research opportunities and possibilities within the Adult Learning Resources Center;

--Review examples of current related research;

--Suggest specific research problem areas; and

--Delineate desired methodological procedures.

The major goal of the Developmental and Demonstration Project in Adult Basic Education at North Carolina State University is to identify, develop, and evaluate innovative materials and instructional systems that will accelerate and enhance the learning process in undereducated adults through the use of modern educational technology and media. Emphasis has been placed on determining the appropriate role of computer assisted instruction (CAI), programmed instruction (PI), and other self-instructional media in teaching adults.

The overall objectives for the five-year project are to:

--Identify and define desired behavioral changes to be effected in undereducated adult learners in the cognitive, affective, and psychomotor domains in the areas of reading and communication, computation, citizenship, consumer education, and home and family life.

--Identify in subject-matter areas specified in objective 1, the content, concepts, and skills within which behavioral changes in the undereducated adult need to be effected.

--Design instructional strategies for meaningful organization of learning experiences in order to meet objective 1.

--Evaluate the effectiveness of available programmed materials and develop new instructional systems and materials for use with instructional strategies utilizing programmed texts, computer assisted instruction, and other educational technologies.

--Develop in-service and pre-service training components, designed to build and increase the competence of adult basic education teachers, administrators, and Project staff in the development and use of new forms of educational technology and media.

The general design of the Project encompasses the major dimensions of curriculum development, research and evaluation, and training and dissemination. This report is concerned with the research and evaluation activities of the Project.

Prerequisite to the construction of specific research designs is the clear identification and delineation of the Project's subgoals and objectives that will be necessary to accomplish the broad objectives stated in the Project proposal. The opportunities and possibilities for research within the Project are limited only by the imagination; however, pragmatic concerns necessitate the establishment of a hierarchy of relevant research needs.

Designs must be constructed that will:

--Evaluate the degree of accomplishment of our stated objectives,

--Provide a body of valid data in regard to the learning processes of the undereducated adult,

--Discover principles of learning that could lead to the construction of a valid learning theory for the undereducated adult, and

--Generate a heuristic climate that will stimulate the creative research activities of our graduate students and Center staff.

Review of Related Research

Prior to the suggestion of possible research problem areas, current related research was reviewed. There is a definite paucity of reports of research directly related to the undereducated adult learner. Selected examples are presented to illustrate the types of problems that are under investigation. As specific problems are identified for study and prior to the construction of specific research designs, comprehensive reviews of the related literature will be accomplished to avoid unnecessary duplication, suggest testable hypotheses, provide comparative data, and suggest appropriate research methods.

The relationships between training methods and learner characteristics were investigated by Tallmadge (27) to determine if training effectiveness could be increased by employing training methods which differed as a function of trainee characteristics. No significant interactions were found among the three training methods studied and the 16 learner aptitude and interest measures.

Lublin (20) reported on a study of interest patterns of male collegiate technical students by Taylor, Lezotte, and Bondy, who found that interest measures do differentiate

between successful and nonsuccessful technical students. The successful technical student seems to be "thing"-oriented and the unsuccessful technical student, "people"-oriented. The interest patterns of the males in the study supports Roe's (23) hypothesis of a "person-nonperson" orientation. The results also agree with the "things versus people" bipolar factor identified by Thurstone (28) and supported by Strong (25).

A study by Averill (2) at the University of Wisconsin on educational participation and innovativeness investigated the relationships between openness and age, formal schooling, and socio-economic measures, and between openness and participation in educational activities. The results indicated that the relationship between educational participation and a measure of innovativeness could not be explained by such factors as age, formal schooling, and socio-economic conditions. The central finding of the study was that the person who reads, studies, and participates in various forms of education is the person who is open to new ideas and practices.

Erickson (8), in a study of programmed learning and personality styles, found no significant differences between the learning rates of students using programmed materials and those using conventional procedures. Students accustomed to programmed materials were less rigid in their perceptions, but the differences between the groups on personality measures were not pronounced. Erickson concludes that future studies

should compare individual characteristics with success or failure in programmed learning.

Student achievement in classes needs to be investigated, with attention focused on such factors as out-of-class study habits, emotional adjustments, motivation, interest, persistence, health, and others.

Lublin (20), in a study of reinforcement schedules, scholastic aptitude, autonomy need, and achievement in a programmed course, found that the groups receiving no reinforcement and variable-ratio reinforcement scored significantly higher on the criterion test than the group receiving continuous reinforcement. The above-average scholastic aptitude group scored significantly higher than the below-average aptitude group. The autonomy-need group, with the low-autonomy need scores, scored significantly higher than the group with the high-autonomy need scores. The results of the variable-ratio schedule of reinforcement agree with the results of Skinner and others.

Warner (29), in an experimental study of audio-visual reinforcement in a beginning reading program, investigated the difference in the amount of gain in oral reading and silent reading achievement between groups using a machine and accompanying materials and a group that did not use the accompanying audio-visual materials.

His conclusions indicate that the group without the accompanying audio-visual materials used more teacher assistance,

sounded out more words, and correctly identified more words on the Dolch Oral Word Test. There were no significant differences between the groups on silent reading ability. In the area of silent reading, the experiment failed to demonstrate clearly the superiority of the Language Master as a teaching aid. Pupils from lower socio-economic levels used significantly more teacher aid and made a significant reduction in incorrect word substitution on the Dolch Oral Word List Test.

The study implies that, in the initial phases of reading, reinforcement and prompting may be more effective when done by a teacher than by a mechanical device. It also implies that mechanical means may prove more effective with groups of older students at higher levels of reading ability and skill.

Gallegos (9) compared experimenter pacing and student pacing of programmed instruction and examined the effects of fast, slow, and self-paced modes in programmed instruction. The findings indicate that slower-than-average pacing and self-pacing are significantly superior to fast pacing for both high and low-ability students. Low-ability students do better under external pacing, which is slower than self-pacing.

The results suggest that low-ability subjects are unable to determine the most appropriate rate for proceeding in self-instructional materials. These findings support the results reported by Maccoby and Sheffield (21), who concluded that intelligent students use appropriate self-pacing and low-ability students need controlled pacing selected by the trainer.

The results reported by Gallegos and Maccoby and Sheffield suggest that the low-ability student tends to overestimate his ability or does not wish to accept the reality of his low ability.

Campean (5), in a study of test anxiety and feedback in programmed instruction, found that learning can be improved by adjusting programming procedures to adapt to individual differences in test-anxiety level. This study suggests that programmed instructional materials should be designed to use the types of reinforcement, cues, feedback, prompting, etc., that produce the least anxiety in the individual student.

Hall et al. (12) investigated the effectiveness of providing full-response feedback or gradient-response feedback. Significant differences in learning time were found favoring full-response feedback.

Guthrie and Lumsdaine (11) suggest that the adjustment of gradient feedback will require instrumentation with considerable versatility. This is an area in which experimentation with CAI would be of considerable interest.

Anderson et al. (1), in a study of "overprompting" in programmed instruction, found that a group receiving a standard program scored higher on the post-test than the group that took the heavily prompted version. Response mode made no difference. The results show that arrangements of lesson material that permit a student to respond correctly without noticing the cues undermines performance.

Prompting is used in most programmed instruction, and is technically defined as a stimulus which exerts varying degrees of control over a response. A prompt is a hint, clue, etc. Cook and Spitzer (6) argue that the correct answer should be indicated to the student before he makes his response, which implies that there is no such condition as "overprompting." Anderson et al. (1) agree that prompting can be used to great advantage and that it does shorten the time to complete; however, overprompting can occur when the student can supply the correct answer to a prompt without the cues.

Gilman (10), in a study of feedback, prompting, and overt correction procedures in nonbranching CAI programs at Pennsylvania State University, found no differences in learning or retention were obtained for a CAI program which incorporated response contingent feedback, prompting, and overt correction procedures when compared to a CAI program which simply typed the correct response following a student response. No significant differences in learning or retention were obtained between presentations of the instructional program by a teletypewriter and by programmed texts. The instruction presented by CAI took significantly more instructional time than the programmed text.

Dick (7) and Wodtke (30) suggest that CAI may provide a more stimulating learning environment than repetitive programmed texts. The typewriter, slide projector, and tape recorder may provide for increased attention or stimulus

orientation. Wodtke further suggests that the "pin-ball machine effect" may facilitate high levels of attention for long periods of time and that these effects may be due to the novelty of the instructional method. Levels of attention may wear off or they may be long-lasting and result from certain properties of tutorial interaction which students find highly reinforcing.

Hunt's (17) findings clearly demonstrate that retroactive and proactive interactions effects can interfere during concept learning. In general, Newton and Hickey (22) conclude that sequence of the items in a self-instructional program can make a difference in speed of learning and in transfer. Support is also provided for the findings that the conditions most beneficial to rapid learning of a verbal concept do not necessarily result in the greatest transfer.

Holland and Kemp (16) developed a quantitative measure for the degree to which teaching-machine material is programmed. This measure of the blackout ratio is the percentage of words that can be obliterated in a program without increasing the error rate. This measure was demonstrated with a program in which 69 percent of the words were removed without influencing error rate. They conclude that a quantitative measure of the degree to which material is response-contingent or programmed is essential before some of the more popular research questions can be answered. Comparison studies of response modes cannot be reasonably completed unless the dependence of answers on the content has been established. In

the absence of such a dependency, the form of response should not matter. They suggest that the programmer, researcher, and user of programmed materials can determine the degree to which material is programmed by the error rate and the black-out ratio. As definitive properties of a program, both are necessary but neither, alone, is sufficient.

The findings of Swets (25) and reviews by Holland (15) support the conclusions of Stolurow and Davis (24) that, after examining numerous comparative studies, there are typically no significant differences in the relative effectiveness of teaching machines and programmed texts.

In a comprehensive summary and review of investigations related to reading by Harris et al. (13), the following types of studies were noted:

I. The Sociology of Reading
   A. Environmental Influences
      1. Language ability and social class
      2. Reading and mobility
   B. Characteristics of Reading Materials
      1. Analysis of high-frequency vocabulary
      2. Analysis of mass media content
   C. Reading Habits and Preferences
      1. Motives for reading
      2. Children's magazine preferences
      3. Mass media use
      4. Media preferences and personality
   D. Psycho-social Effects of Reading
      1. Reader attitudes toward newspaper roles
      2. Reader participation and opinion change
      3. Measurement of psycho-social effects

II. The Psychology of Reading
   A. Psychological Correlates of Reading Achievement
      1. Personality and Adjustment
      2. Intelligence and related abilities
      3. Conditions in the home
      4. Multiple psychological factors

B. Aspects of the Learning Process
   1. Perceptual-motor factors
   2. Auditory-visual discrimination
   3. Stimulus characteristics
   4. Learner characteristics
   5. Stimulus/learner interactions
   6. Learning conditions
C. Components of the Reading Task
   1. Cognitive factors
   2. Format

III. The Physiology of Reading
A. Neurological Aspects of Reading
   1. Laterality and reading
   2. EEG patterns in poor readers
B. Sensory Integration and Reading
C. Vision and Reading
   1. Visual field and word recognition
   2. Measurement of preschool visual acuity
   3. Oculomotor spasms and reading disability

IV. The Teaching of Reading
A. Federally Supported Studies
B. The Teacher and Reading Instruction
C. Analysis of Reading Materials
D. Utility of Phonic Generalizations
E. Developmental Aspects of Reading Instruction
   1. Reading readiness
   2. Early reading
   3. Administrative organizations for instruction
   4. Sex differences and reading achievement
   5. Comparative methods of reading instruction
   6. Orthography and reading
   7. Use of context clues
   8. Audio-visual aids and reading instruction
   9. Reading instruction for the disadvantaged
   10. Reading instruction in high school
F. Assessment and Prediction of Reading Achievement
   1. Reading readiness
   2. Predicting reading achievement
   3. Test development
   4. Comparative testing
   5. Residual gains in achievement
G. Reading Improvement
   1. College
   2. Adult
H. Remediation of Reading Difficulties

From the preceding presentation of the selected examples of related research, it is obvious that many variables are being investigated. It is equally obvious that little

research is being conducted with undereducated adults. Most of the research being conducted is concerned with elementary, secondary, and college populations.

The implication is that many of the current variables and factors under investigation, as well as new ones, need to be studied using undereducated adult populations. Current psychological and sociological principles, as well as innovative hypotheses, need to be tested and validated with samples of undereducated adults.

Suggested Research Areas

The suggested research problems will be presented in two basic categories: the student and the learning environment. The learning environment includes the various content areas, the instructional strategies employed, and the physical environment, which includes the various materials and equipment. The areas are not mutually exclusive and are used only as a matter of convenience in classifying possible research.

As specified in the Project proposal, the content areas being treated are:

--Reading and Communication
--Computation
--Citizenship
--Consumer Education
--Home and Family Life.

The broad research areas to be suggested could apply to each of the five content areas.

Research has been defined in various ways. Kerlinger (18: 11) states that "scientific research is systematic,

controlled, empirical, and critical invetigation of hypothetical propositions about the presumed relations among natural phenomena."

Others have defined research as "problem-solving," "truth-seeking," "reflective thinking," etc. Bledsoe (3) states that research involves a critical and thorough investigation or experimentation which aims to arrive at new truths or to revise existing knowledge. In its applied sense it is a systematic attempt to solve problems of major importance. Reduced to its simplest form, the research process has three features: ask a good question, answer or attempt to answer the question well, and carefully report the results of the process.

For the purposes of this paper, research questions will be posed in the specified categories. When the posed questions are deemed appropriate and worthy of further study, specific designs with the necessary data treatments will be constructed.

The Student

I. What are the characteristics of the population?

A. Socio-economic
1. Sex
2. Age
3. Marital status
4. Number of dependents
5. Parent's background
6. Employment record
7. Occupation
8. Income
9. School record

10. Residence
11. Birthplace
12. Race or ethnic group
13. Health record

B. Personality
1. Adjustment
2. Emotional stability
3. Aptitudes
4. Achievements
5. Interest
6. Preferences
7. Goals
8. Motives
9. Problems
10. Needs
11. Self-concepts
12. Attitudes

II. Are the content areas identified appropriate and relevant for the target population?

III. Are the identified behavioral objectives and concepts arranged in the most appropriate hierarchy in view of the population characteristics?

IV. Are the desired behavioral objectives acceptable to the learner?

V. What are the relationships between program length and student retention and achievement rates?

VI. How do students respond to different means of material presentation?

VII. What are the effects of different presentation means on:

A. Motivation
B. Persistence
C. Successful Completion
D. Retention
E. Transfer
F. Anxiety Level
G. Error Rate

VIII. What method of follow-up of participants is to be used?

A. Drop-Outs
1. Reason for withdrawal
2. Current activities
3. Future plans

B. Successful Students
   1. Comparisons of preprogram and postprogram characteristics
   2. Current activities
   3. Future plans

The Learning Environment

I. Computer Assisted Instruction
   A. Is CAI a more efficient means of teaching the content areas than PI?
   B. Does a combination of CAI and PI instruction produce more efficient learning than either does alone?
   C. Which individual CAI presentation mode or combination of modes facilitates learning best?
   D. What is the optimal rate of material presentation?
   E. Can CAI developed materials be presented via other programmed means?
   F. Are color films more stimulating than black and white films?
   G. How much and what type of learner participation should be programmed?
   H. Which instructional strategies are most effective?
      1. Which methods of reinforcement facilitate learning via CAI?
      2. Which methods are most efficient?
      3. How much prompting is appropriate for this population?
      4. Which instructional strategies produce
         a. Least error rate?
         c. Best retention?
      5. What is the effect of the length of programs or segments of a program on learning?
      6. How much response time is appropriate for the different programs?
      7. How does content material presented via CAI compare with material presented via other audio-visual means in facilitating learning?
         a. Victor electrowriter
         b. Video tape
         c. Class lectures
         d. Other audio-visual devices
      8. What is the effect of order of presentation of concepts on learning efficiency?

II. Programmed Instruction
   A. Is our evaluative instrument for programmed instruction valid?
   B. Should currently available programmed materials be evaluated in regard to basic concepts presented?

C. How do the various currently available commercial materials compare with each other as evaluated by the Project-developed instrument?
D. How do PI materials compare in use with selected samples from the population?
E. Do certain types of PI materials facilitate learning in the undereducated adult?
F. How do non-Project PI materials compare with Project-developed materials in teaching the specified content areas?
G. Which combinations of hardware and software accelerate learning for students with certain patterns of socio-economic and personality characteristics?

Miscellaneous Theoretical Considerations

There are numerous learning theories and each, of course, has a definition of learning. Hilgard (14: 7-8) lists several questions that an acceptable theory of learning should seek to answer. These questions have obvious implications for research with the undereducated adult.

1. What are the limits of learning? Here is raised the question of the capacity to learn, of individual differences among learners of the same species and of unlike species. There are questions not only of persistent differences in capacity, but of change in capacity with age. Who can learn what? Are the limits set at birth? Do people get more or less alike with practice? These are the sorts of questions which it is natural to raise.

2. What is the role of practice in learning? The old adage that practice makes perfect has considerable racial wisdom behind it. Surely one learns to roller skate or to play the piano only by engaging in the activity. But what do we know about practice in detail? Does improvement depend directly on the amount of repetition? If not, what are its conditions? What are the most favorable circumstances of practice? Can repetitive drill be harmful as well as helpful to the learner?

3. How important are drives and incentives, rewards and punishments? Everybody knows in a general way that learning can be controlled by rewards and punishments, and that it is easier to learn something which is

interesting than something which is dull. But are the consequences of rewards and punishments equal and opposite? Is there a difference between intrinsic and extrinsic motives in their effect upon learning? How do goals and purposes affect the process?

4. What is the place of understanding and insight? Some things are learned more readily if we know what we are about. We are better off as travelers if we can understand a timetable or a road map. We are helpless with differential equations unless we understand the symbols and the rules for their manipulation. But we can form vowels satisfactorily without knowing how we place our tongues, and we can read without being aware of our eye movements. Some things we appear to acquire blindly and automatically; some things we struggle hard to understand and can finally master only as we understand them. Is learning in one case different from what it is in the other?

5. Does learning one thing help you learn something else? This is the problem of formal discipline, as it used to be called, or of transfer of training, to use a more familiar contemporary designation. Some transfer of training must occur or there would be no use in developing a foundation for later learning. Nobody denies that it is easier to build a vocabulary in a language after you have a start in it, or that higher mathematics profits from mastery of basic concepts. The question is really one of how much transfer takes place, under what conditions, and what its nature is.

6. What happens when we remember and when we forget? The ordinary facts of memory are mysterious enough, but in addition to familiar remembering and forgetting, our memories may play peculiar tricks on us. In cases of amnesia there are often gaps in memory, with earlier and later events remembered. Then there are the distortions of memory, in which we remember what did not happen, as is so strikingly demonstrated in testimony experiments. What is taking place? What control have we over processes involved?

Despite the numerous theoretical positions and the variety of answers offered to these questions, Hilgard

(14: 486-487) lists some areas of learning on which most theorists tend to agree:

1. In deciding who should learn what, the capacities of the learner are very important. Brighter people can learn things less bright ones cannot learn; in general, older children can learn more readily than younger ones; the decline of ability with age, in the adult years, depends upon what it is that is being learned.

2. A motivated learner acquires what he learns more readily than one who is not motivated. The relevant motives include both general and specific ones, for example: desire to learn, need for achievement (general), and desire for a certain reward or to avoid a threatened punishment (specific).

3. Motivation that is too intense (especially pain, fear, anxiety) may be accompanied by distracting emotional states, so that excessive motivation may be less effective than moderate motivation for learning some kinds of tasks, especially those involving difficult discriminations.

4. Learning under the control of reward is usually preferable to learning under the control of punishment. Correspondingly, learning motivated by success is preferable to learning motivated by failure. Even though the theoretical issue is still unresolved, the practical outcome must take into account the social by-products, which tend to be more favorable under reward than under punishment.

5. Learning under intrinsic motivation is preferable to learning under extrinsic motivation.

6. Tolerance for failure is best taught through providing a backlog of success that compensates for experienced failure.

7. Individuals need practice in setting realistic goals for themselves, goals neither so low as to elicit little effort nor so high as to foreordain to failure. Realistic goal-setting leads to more satisfactory improvement than unrealistic goal-setting.

8. The personal history of the individual, for example, his reaction to authority, may hamper or enhance his ability to learn from a given teacher.

9. Active participation by a learner is preferable to passive reception when learning, for example, from a lecture or a motion picture.

10. Meaningful materials and meaningful tasks are learned more readily than nonsense materials and more readily than tasks not understood by the learner.

11. There is no substitute for repetitive practice in the overlearning of skills (for instance, the performance of a concert pianist), or in the memorization of unrelated facts that have to be automatized.

12. Information about the nature of a good performance, knowledge of his own mistakes, and knowledge of successful results aid learning.

13. Transfer to new tasks will be better if, in learning, the learner can discover relationships for himself, and if he has experience during learning of applying the principles within a variety of tasks.

14. Spaced or distributed recalls are advantageous in fixing material that is to be long retained.

These areas of agreement have been validated in numerous research situations and offer fruitful opportunities for investigations with the undereducated adult population.

The list of research possibilities could be expounded ad infinitum, but the preceding examples illustrate the types of research that could be attempted with this project. Within each of the broad areas listed are numerous subproblems. The immediate problem, therefore, is to select those areas that are most essential to the successful obtainment of the Project's stated objectives and have the greatest relevance for undereducated adults.

In all of the Project's research endeavors, emphasis should remain on the practical application of the Project's outputs to the needs of the undereducated adult. The learner must remain the focus of our concern.

Methodological Procedures

Types of Design. Many of the important variables in educational research cannot be manipulated and, therefore, do not accommodate a true experimental design. These variables, however, can be studied and controlled by utilizing various quasi-experimental, ex post facto, and survey designs.

Conversely, some of the problems do lend themselves to experimental designs and the opportunity to use these designs is afforded by the Project's learning laboratory, where samples of undereducated adults can be exposed to and compared on various important educational variables in a controlled instructional environment.

The comprehensiveness and diversity of the Project's objectives and the nature of the variables to be investigated dictate the use of a variety of research designs. Basically, the Project lends itself to the utilization of three types of research: experimental, ex post facto, and survey. There are numerous variations within each type, the appropriateness of the design being determined by the nature of the problem.

Selection of the Subjects. If the results obtained from this federal project are to be generalized to the undereducated adult population, every effort must be made to select subjects that are as representative as possible of the target population. This is a difficult problem. The ideal solution--random selection--often is impractical. In this particular situation, however, one may be able to approach random selection.

Ideally, one should contact all the related agencies dealing with undereducated adults, including those agencies that have requested training services. Request from the identified agencies lists of eligible students. One may randomly select a sample for recruitment and enrollment from these lists and drop-outs, as they occur, can be randomly replaced to keep the sample figure at the desired number.

Following random selection, the students will be randomly assigned to the various experimental treatments. For example, if 50 students need reading instruction and one of the designs is to compare two or more programmed instruction techniques, then the students should be randomly assigned in equal numbers to various treatment groups.

Random selection and random assignment increases the probability of representative samples and equalization of the groups. When randomization is not possible, various statistical methods can be employed to compensate for the weakness of the design.

Fisher's invention of the analysis of covariance allows statistical matching of students. Kerlinger (18) states that analysis of covariance statistically matches students, and one obtains the advantages of random assignment and the benefits of matching. If the assumptions behind analysis of variance are met, this method has broad application in many educational research situations.

Collection of the Data. Complete and comprehensive records will be maintained on each student. The various evaluative instruments to be used will be dictated by the specific designs; however, certain common data will be routinely collected from all participants.

Each student in the program will be given an initial interview, regular periodic in-program interviews, and an exit interview. Standardized interview schedules will be constructed for these purposes. A selected battery of tests will be administered to all participants. This battery of tests should lend itself to a pre-test/post-test situation. In addition to the periodic interviews, each student will have access to counseling services and records of these sessions will be maintained for analysis.

When currently available commercial evaluative instruments are not appropriate for these purposes, the needed instruments will be constructed and their reliability and validity will be ensured prior to use in a specific research design. Various instruments can be constructed in-house by exposing samples of students to item pools presented via CAI.

Statistical item analysis can be accomplished with the computer, thus facilitating the construction of reliable and valid instruments for later use in the Project. All data collected will be punched and stored on either cards, tapes, or discs for future analyses and statistical treatments.

Treatment of the Data

The specific data treatments will be dictated by the selected appropriate research designs. All of the statistical treatments will be accomplished by computer with existing programs or new programs to be written in consultation with staff programmers and statisticians.

Possible Designs

The following designs, with examples of variables have wide applicability to numerous experimental problems and can be expanded to include several groups and treatments.

I. EXPERIMENTAL GROUP/CONTROL GROUP

$$\boxed{R} \quad \begin{array}{c|c} X & Y \\ \hline (\sim X) & Y \end{array}$$

[R] = random assignment

X = CAI reading instruction

(~X) = Control group

Y = Reading achievement

II. MULTIPLE EXPERIMENTAL GROUPS

	X^1	Y
R	X^2	Y
	X^3	Y

R = random assignment--all groups

X^1 = CAI reading program

X^2 = PI reading program

X^3 = Victor electrowriter program

Y = reading achievement

III. PRE-TEST/POST-TEST CONTROL GROUP

	Y^b	X	Y^a
R			
	Y^b	(~X)	Y^a

R = random assignment--all groups

Y^a = after reading achievement

Y^b = before reading achievement

X = Language Master vocabulary drills

(~X) = control group

IV. PRE-TEST/POST-TEST MULTIPLE GROUPS

	Y^b	X^1	Y^a
R	Y^b	X^2	Y^a
	Y^b	X^3	Y^a

R = random assignment--all groups

Y^a = reading comprehension after

Y^b = reading comprehension before

X^1 = CAI reading CRT only

X^2 = CAI audio plus CRT

X^3 = CAI all modes

V. PRE-TEST/POST-TEST MULTIPLE GROUPS, MULTIPLE MEASURES

	$Y^{b,1,2,3}$	X^1	$Y^{a,1,2,3}$
R	$Y^{b,1,2,3}$	X^2	$Y^{a,1,2,3}$
	$Y^{b,1,2,3}$	X^3	$Y^{a,1,2,3}$

R = random assignment--all groups

Y^{a1} = reading achievement after

Y^{a2} = interest inventory after

Y^{a3} = emotional adjustment after

Y^{b1} = reading achievement before

Y^{b2} = interest inventory before

Y^{b3} = emotional adjustment before

X^1 = CAI reading program

X^2 = CAI reading plus PI

X^3 = PI reading program

VI. THREE-GROUP FORM--EXPERIMENTAL AND CONTROL

	Y^b	X	Y^a	(Experimental)
[R]	Y^b	(~X)	Y^a	(Control 1)
		X	Y^a	(Control 2)

[R] = random assignment--all groups

Y^a = criteria measurements after

Y^b = criteria measurements before

X = length of CAI sessions

(~X) = control group

VII. FOUR-GROUP FORM--EXPERIMENTAL AND CONTROL

	Y^{b1}	X	Y^{a2}	(Experimental)
[R]	Y^{b3}	(~X)	Y^{a4}	(Control 1)
		X	Y^{a5}	(Experimental)
		(~X)	Y^{a6}	(Control 2)

[R] = random assignment--all groups

Y^a = After tests

Y^b = Before tests

X = A method of reinforcement

(~X) = Control group

Obviously there are numerous variations of the preceding designs. Campbell and Stanley (4) state that the Solomon Four Group Design VII has high prestige and represents the first explicit consideration of external validity factors. The main effects of testing and the interaction of testing and treatment can be determined. Also, the effect of the treatment is replicated four times and the combined effect of maturation and history may be noted by comparing Y^{a6} with Y^{b1} and Y^{b3}. Kerlinger (18) reports that design VII is held in high esteem by social scientists.

All of these designs incorporate the desired and essential features of random assignment, which allows statistical equivalence of the groups, and comparison groups necessary for internal validity.

In addition to the various experimental designs, numerous ex post facto designs can be utilized. Simply explained, these designs start with observed dependent variables and then seek to find independent variables that have already occurred which have probable relations to or effects on the observed dependent variable.

There are also many possibilities for survey research by utilizing field studies to collect descriptive data and to validate experimental results found in the learning laboratory. Questionnaires, interview schedules, etc., can be utilized in these designs.

The numerous educational variables under study can be analyzed in factorial and correlation designs to discover existing relationships and currently unrecognized new dimensions and associations. Multiple correlation and regression analysis can be used to construct prediction formulas, to ascertain the probability of success for various student groups in different curricula within the ABE programs. Whenever possible, substantive hypotheses and various alternative hypotheses should be posed and empirically tested.

Most of the conditions and suggestions offered herein are "ideal" and will probably involve various practical compromises. The preceding "ideals" should, however, provide a basis for discussion that will result in opportunities for significant research contributions to the comparatively small body of knowledge related to the learning processes of the undereducated adult.

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